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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,185	02/09/2004	Kia Silverbrook	MTB27US	8427

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SILVERBROOK RESEARCH PTY LTD
393 DARLING STREET
BALMAIN, 2041
AUSTRALIA

EXAMINER	
FIDLER, SHELBY LEE	
ART UNIT	**PAPER NUMBER**
2861	

MAIL DATE	DELIVERY MODE
10/26/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/773,185	SILVERBROOK, KIA	
	Examiner	Art Unit	
	Shelby Fidler	2861	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 September 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3,5,6,8-21,23-25,27-40 and 42-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,5,6,8-21,23-25,27-40 and 42-54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Responsive Office Action

This Office Action is responsive to the remarks and amendments filed 9/25/2007.

Claim Objections

Claim 40 recites the limitation "the electrodes". There is no antecedent basis for this limitation in the claim.

Claim 40 is objected to as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. This claim states that "the heater element extends . . ." However, because parent claim 38 provides a plurality of heater elements, Examiner is unsure to which heater element this limitation refers. For the purpose of examination, Examiner assumes that the limitation corresponds to each of the plurality of heater elements.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-3, 5, 8, 11-13, 16, 19-21, 23-24, 27, 30-32, 35, 38-40, 42, 44, 47-48; 50, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka (JP 07-5943) in view of Andrews et al. (US 6568792 B2) and Hiramatsu et al. (US 6967312 B2).

Examiner notes that all references made to Manaka (JP 07-5943) are directed towards the translation enclosed herewith.

Regarding claims 1 and 19:

Manaka discloses an ink jet printhead (inkjet printing head 10) comprising:

a plurality of nozzles (nozzle holes 12a);

a bubble forming chamber (ink chamber 13) corresponding to each of the nozzles respectively (Fig. 4B);

a plurality of heater elements (heating part strips 16a1 & 16a2) disposed in each of the bubble forming chambers respectively (Figs. 5 & 6A), each heater element configured for thermal contact with a bubble forming liquid (page 11, lines 11-13), such that,

heating each heater element to a temperature above the boiling point of the bubble forming liquid forms a gas bubble (bubble 17) that causes the ejection of a drop of an ejectable liquid through the associated nozzle (page 11, lines 13-20); wherein,

each heater element is a suspended elongate strip (Fig. 6A).

Manaka does not expressly disclose that each strip has a cross section with a lateral dimension at least triple that of the thickness of that strip and different than a lateral dimension of each other strip, or that the thickness of each strip is less than 0.3 microns.

However, Andrews et al. disclose a heater elements (heater segments 212-216) in the form of elongate strips (Fig. 2), wherein each strip has a different cross sectional lateral dimension than each other strip (Fig. 2).

Manaka as modified by Andrews et al. do not expressly disclose that each strip has a cross sectional lateral dimension at least triple that of the thickness of that strip, or that the thickness of each strip is less than 0.3 microns.

However, Hiramatsu et al. disclose that it is preferable to provide heater elements with a cross sectional lateral dimension (width) at least triple that of the thickness of that heater element (col. 15, lines 46-48).

Manaka as modified by Andrews et al. and Hiramatsu et al. do not expressly disclose that the thickness of each heater element is less than 0.3 microns.

However, at the time of invention, it would have been obvious to a person of ordinary skill in the art to modify the heater element strips of Manaka as modified by Andrews et al. and Hiramatsu et al. to have a thickness of less than 0.3 microns, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to modify Manaka's heater elements to have different cross sectional lateral dimensions, such as disclosed by Andrews et al. One motivation for doing so, as taught by Andrews et al., is to be able to control the size of droplets over a range of sizes (col. 1, line 66 - col. 2, line 7). It would have been further obvious to modify the heater strips of Manaka as modified by Andrews et al. to have a cross sectional lateral dimension that is triple that of the thickness of the strip, Hiramatsu et al. One motivation for doing so, as taught by Hiramatsu et al., is to increase the resistance value of the heating element while keeping the evenness of the temperature on the heating face (col. 15, lines 49-52).

Regarding claims 2 and 20:

Manaka also discloses that the gas bubble is formed on an axis which extends through the center of the nozzle (Figs. 4A & 4B).

Regarding claims 3, 21, and 39:

Manaka also discloses that the bubble forming chamber has a circular cross section (Fig. 13).

Regarding claims 5, 24, and 42:

Manaka also discloses that the bubble forming liquid and the ejectable liquid are of a common body of liquid (page 11, lines 15-20).

Regarding claims 8, 27, and 44:

Manaka also discloses that each heater element (16a1 & 16a2) is configured such that an actuation energy of less than 500 nanojoules is required to be applied to the heater element to heat that heater element sufficiently to form a bubble in the bubble forming liquid thereby to cause the ejection of a drop (page 10, lines 16-17).

Regarding claims 11, 30, and 47:

Manaka also disclose that each heater element (16a1 & 16a2) has two opposite sides and is configured such that a gas bubble (17) formed by that heater element is formed at both sides of that heater element (Figs. 4A & 4B).

Regarding claims 12, 31, and 48:

Manaka also disclose that the bubble which each heater element is configured to form is collapsible and has a point of collapse (obvious to the bubbles 17 as described on page 11, lines 15-22), and that each heater element is configured such that there is a space between the heater elements (Fig. 6A).

Manaka as modified by Andrews et al. and Hiramatsu et al. do not expressly disclose that each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

However, it is known that the heater element configuration disclosed by Manaka, in which a space is formed between the heater elements, provides a bubble collapsing point that is away from the heater elements. Such a teaching is found in, for example Figure 6, of Campbell et al. (US 4870433).

Regarding claims 13, 32, and 50:

Manaka also discloses a structure (cover plate 12) with nozzles (nozzle holes 12a) incorporated thereon (Fig. 5).

Examiner notes the additional limitation that the structure is formed by CVD. However, the method of forming a device is germane to neither the issue of patentability of the device itself, nor to the method of operating the device. Therefore, this limitation has not been given patentable weight.

Regarding claims 16, 35, and 52:

Manaka also disclose that that each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50 (TiN – page 5, lines 8-11).

Regarding claim 23:

Manaka also discloses that the bubble forming liquid (ink) is in thermal contact with each of the heater elements (Fig. 4B), and that the ejectable liquid is supported adjacent each nozzle (Fig. 4B).

Regarding claim 38:

Manaka as modified by Andrews et al. and Hiramatsu et al. disclose all the limitation of claim 1 that apply to claim 38, and **Manaka also discloses** the steps of supply the nozzle with a replacement volume of the liquid equivalent to the ejected drop (obvious to the hydraulic resistance created by ink feed channel 14 described on page 10, line 21 - page 11, line 1); and

forming the gas bubble (17) on an axis which extends through the center of the nozzle (Fig. 4C).

Regarding claim 40:

Manaka also disclose that the heater elements (16a1 & 16a2) extend between electrodes (lead parts 16b) mounted on opposite sides of the bubble forming chamber (Figs. 5 & 6A).

Claims 6, 10, 25, 29, 43, and 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka as modified by Andrews et al. and Hiramatsu et al., as applied to claims 1 above, and further in view of Silverbrook (US 6019457).

Regarding claims 6, 25, and 43:

Manaka as modified by Andrews et al. and Hiramatsu et al. disclose all claimed limitations except that the printhead is configured to be a pagewidth printhead.

However, Silverbrook discloses a printhead that is configured to be a pagewidth printhead (col. 2, lines 19-22).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to configure the printhead of Manaka as modified by Andrews et al. and Hiramatsu et al. to be a pagewidth printhead, such as disclosed by Silverbrook. One motivation for doing so, as taught by Silverbrook, is to be able to print on an A4 page (col. 6, lines 7-12).

Regarding claims 10, 29, and 46:

Manaka as modified by Andrews et al. and Hiramatsu et al. disclose all claimed limitations except that the substrate having a substrate surface, wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square centimeter of substrate surface.

However, Silverbrook also discloses a substrate having a substrate surface, wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square centimeter of substrate surface (using the reference measurement of Figure 43 and counting the individual nozzles disclosed in the "part of cyan" section of Figure 43, calculations show that the density exceeds 10,000 per square cm: $\frac{20 nozzles}{0.0016384 cm^2} = 12207 \frac{nozzles}{cm^2}$).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a high nozzle density, such as taught by Silverbrook, into the invention of Manaka as modified by Andrews et al. and Hiramatsu et al. The motivation for doing so, as taught by Silverbrook, is to provide four nozzles per pixel (col. 16, lines 60-63).

Claims 9, 28, and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka as modified by Andrews et al. and Hiramatsu et al., as applied to claims 1 above, and further in view of Otsuka et al. (US 5485179).

Regarding claims 9, 28, and 45:

Manaka as modified by Andrews et al. and Hiramatsu et al. disclose all claimed limitations except that the heater element is configured such that the energy required to be applied thereto to heat the heater element to cause the ejection of a drop is less than the energy

required to heat a volume of the ejectable liquid equal to the volume of the drop, from a temperature equal to the ambient temperature to the boiling point.

However, Otsuka et al. disclose a heater element is configured such that the energy required to be applied thereto to heat the heater element to cause the ejection of a drop is less than the energy required to heat a volume of the ejectable liquid equal to the volume of the drop, from a temperature equal to the ambient temperature to the boiling point (col. 13, lines 21-28 shows that the energy required to heat the heater is less when the ambient temperature is high, and more when the ambient temperature is low; therefore, Otsuka teaches that it would take less energy to eject a drop of ink than it would to heat ink from an ambient temperature to a boiling temperature).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize Otsuka's heating configuration into the invention of Manaka as modified by Andrews et al. and Hiramatsu et al. The motivation for doing so, as taught by Otsuka, is to control the temperature of the recording head based on the present ambient temperature (col. 12, lines 41-49).

Claims 14, 33, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka as modified by Andrews et al. and Hiramatsu et al., as applied to claims 1, 19, and 38 above, and further in view of Rausch et al. (US 6857727 B1).

Regarding claims 14, 33, and 49:

Manaka also discloses that the printhead comprises a structure (cover plate 12) on which nozzles (nozzles 12a) are incorporated (Fig. 5).

Manaka as modified by Andrews et al. and Hiramatsu et al. do not expressly disclose that the structure is less than 10 microns thick.

However, Rausch et al. disclose a printhead (printhead assembly 12) comprising a nozzle plate (orifice plate 60) that is about 10 microns thick (col. 5, lines 44-47 and col. 6, lines 8-11).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize the nozzle plate structure of Rausch et al. into the invention of Manaka as modified by Andrews et al. and Hiramatsu et al. The motivation for doing so, as taught by Rausch et al., is to provide more consistent and uniform formation of orifices (col. 7, lines 11-18).

Claims 15, 18, 34, 37, 51, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka as modified by Andrews et al. and Hiramatsu et al., as applied to claims 1, 19, and 38 above, and further in view of Kubby (US 5706041).

Regarding claims 15, 34, and 51:

Manaka also discloses a plurality of nozzle chambers (ink chambers 13), each corresponding to a respective nozzle (Fig. 5).

Manaka as modified by Andrews et al. and Hiramatsu et al. do not expressly disclose that the heater elements within each chamber being formed on different respective layers to one another.

However, Kubby discloses a plurality of heater elements (doped regions 20a & 20b) in a single nozzle chamber (cavity 16 - Fig. 2), wherein the heater elements are formed on different respective layers to one another (col. 4, lines 32-52 and Fig. 4).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to place the heater elements of Manaka as modified by Andrews et al. and Hiramatsu et al. onto different layers, such as disclosed by Kubby. One motivation for doing so, as taught by Kubby, is to allow the top heater element to dissipate heat mostly upwards, and to allow the bottom heater element to dissipate heater mostly downwards (col. 4, lines 50-52).

Regarding claims 18, 37, and 54:

Manaka as modified by Andrews et al. and Hiramatsu et al. disclose all claimed limitations except that each heater element is covered with a conformal protective coating, the coating of each heater element having been substantially applied to all sides of the heater element such that the coating is seamless.

However, Kubby discloses covering each heater element (polysilicon layers Poly1 & Poly2) with a conformal protective coating (Tantalum protective layer) on all sides of the heater element such that the coating is seamless (col. 4, lines 13-22 and Fig. 4).

Examiner notes the additional limitation that the coating is applied to all sides simultaneously. However, this limitation relates to the method of forming a device, which is not germane to the issues of patentability of the device itself or to a method of operating the device. Therefore, this limitation has not been given patentable weight.

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a conformal protective coating, such as that disclosed by Kubby, into the invention of Manaka as modified by Andrews et al. and Hiramatsu et al. One motivation for doing so, as taught by Kubby, is to prevent corrosion of the semiconductor structures from contact with the ink (col. 4, lines 13-22).

Claims 17, 36, and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka as modified by Andrews et al. and Hiramatsu et al., as applied to claims 1, 19, and 38 above, and further in view of DeMoor et al.

Regarding claims 17, 36, and 53:

Manaka also disclose that each heater element (16a1 & 16a2) is a solid material (page 5, lines 8-11) and is configured to be heated to a temperature above the boiling point thereby to heat the part of the bubble forming liquid to a temperature above the boiling point to cause the ejection of a drop (page 10, lines 3-11).

Manaka as modified by Andrews et al. and Hiramatsu et al. do not expressly disclose the heater element is less than 10 nanograms.

However, DeMoor et al. disclose a heater element is less than 10 nanograms (page 285, Fabrication: Ti thickness = 5nm; TiN thickness = 30nm; heater width = 2000μm; heater width = 0.4μm. Therefore, the volume of Ti within the heater is $4*10^{-12}$ cm^3, and the volume of TiN within the heater is $2.4*10^{-11}$ cm^3. Using the known densities of Ti = 4.54 g/cm^3 and TiN = 5.22 g/cm^3, the heater element has an entire mass of 0.14344 ng).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize De Moor et al.'s heater element mass into the invention of Manaka as modified by Andrews et al. and Hiramatsu et al. The motivation for doing so, as taught by De Moor et al., is that these heaters show excellent resistivity uniformity and a low TCR value (page 293, Conclusions).

Response to Arguments

Applicant's arguments with respect to claims 1, 19, and 38 have been considered but are moot in view of the new ground(s) of rejection. Please see the above combination-type rejection based on the disclosures provided by Manaka, Andrews et al., and Hiramatsu et al. A logical combination of these references teaches that it would have been obvious to produce an ink jet printhead comprising a plurality of suspended, elongate, heater element strips disposed in each of the bubble forming chambers, wherein each strip has a cross section with a lateral dimension that is different than a lateral dimension of each other strip.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Communication with the USPTO

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shelby Fidler whose telephone number is (571) 272-8455. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Luu can be reached on (571) 272-7663. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Shelby F. Fidler 10/19/2007

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